

as at Mobile, viz., about once in four years; Shreveport, La., Memphis, Tenn., and Charleston, S. C., with records of fifteen years, or more, show one each.

The sections of country in which daily rainfalls of 2.50, or more, inches have occurred in March are much the same as those for which the largest monthly rainfalls are given. These excessive daily rainfalls are shown to have been most frequent in Tennessee, Alabama, and Mississippi, and, as with the heaviest monthly rainfalls, the records at Mobile, Ala., show the largest number, viz., thirteen for a period of eighteen years. Along the New Jersey and southern New England coasts there have been recorded at a number of stations from one to three daily rainfalls in excess of 2.50 inches. In the Lake region and central valleys they have occurred at very few sta-

tions; Saint Louis, Mo., and Fort Hays, Kans., report two each, but no other station in these last-named districts show more than one, and at a majority of stations no such daily rainfalls have occurred. In California there were two at Los Angeles, and one each at San Francisco, Sacramento, and San Geronio.

The records for March show but few instances of rainfalls of one inch, or more, per hour, and the stations reporting same are sparsely located. Even in the Gulf States, where the excessive daily and monthly rainfalls have occurred with greatest frequency, there have been very few rainfalls reaching a rate of one inch per hour. The rainfall of 4.10 inches in thirty minutes at Biscayne, Fla., on March 28, 1876, is the heaviest shown by the records.

## WINDS.

The most frequent directions of the wind during March, 1888, are shown on chart ii, by arrows flying with the wind. In the Missouri, upper Mississippi, and Ohio valleys, Lake region, New England, the middle Atlantic states, and on the California coast the winds were west, northwest, or north; in the west Gulf states and southern slope, southerly; and in other districts, variable.

### HIGH WINDS (in miles per hour).

The maximum velocities of the wind for March, 1888, at Signal Service stations where the movements are registered, are given in the table of miscellaneous meteorological data. Other than the maximum velocities given in the table referred to, the following velocities of fifty, or more, miles per hour have been reported: Fort Canby, Wash., 60, sw., 11th; 56, w., 12th; 56, s., 13th; 63, s., 31st. Eastport, Me., 60, e., 12th. Mackinaw City, Mich., 58, se., 26th. Hatteras, N. C., 55, nw., 11th; 50, w., 22d. Fort Totten, Dak., 52, n., 19th. Block Island, R. I., 50, n., 13th.

### LOCAL STORMS.

Sedgwick, Sedgwick Co., Kans.: a local storm, having the characteristics of a tornado, occurred in this vicinity about 5.30 p. m. on the 1st. The storm was accompanied by rain and hail, and destroyed buildings west of here and at Newton, ten miles northeastward.

Another report of the above mentioned storm, received from Halstead, Harvey Co. (lying to the northward of Sedgwick county), states that it also passed through portions of Reno and Kingman counties, its general course being n. 55° e. At one point in the storm's path the soft earth was scooped out to a depth of one foot in a place twenty feet in diameter, and other instances of the violence of the storm are given.

Emporia, Linn Co., Kans.: a very heavy rain storm, accompanied by incessant lightning, began at 7 p. m. of the 1st and continued for about an hour. It is reported that the storm had the characteristics of a tornado at a point a few miles west of the city, where considerable damage was done.

San Francisco, Cal.: light and heavy rain, accompanied by small hail, fell alternately during the day of the 4th, and high winds prevailed from 12.55 until 1.55 p. m., reaching a maximum velocity of thirty-six miles per hour. Nearly all vessels in the harbor dragged their anchors during the storm, and many sustained damage from collision, etc. The barges "Victor" and "Hills Ferry," lumber-laden, were sunk; the steamer "Alice Garrett," with thirty-two persons in quarantine, parted her cables during the height of the gale and drifted towards the wharves, damaging her upper works and then capsizing; no lives were lost.

Galveston, Tex.: a light south wind prevailed during the afternoon of the 10th, and at 6.15 p. m. it shifted suddenly to north and attained a velocity of fifty miles per hour at 10.55 p. m.; the high wind continued until in the forenoon of the following day. This was the severest wind storm experienced

in this city since March 13, 1883, when a velocity of sixty-one miles per hour was recorded. Trees, chimneys, and telegraph wires were blown down during the storm.

Spring Hill, Montgomery Co., Ga.: during the early morning (about 4 a. m.) of the 21st a tornado passed in an easterly direction through Telfair county causing the destruction of a number of buildings and the loss of several lives in the vicinity of Lumber City. Reports indicate that this was a well-defined tornado, and numerous instances of the violent force of the wind usually accompanying such storms are given. Mr. A. M. Moses, postmaster at Tupper, Montgomery Co., states that articles of merchandise contained in stores that were destroyed at Lumber City were blown distances of ten to twenty miles.

Bobo, Gordon Co., Ga.: at about 11 p. m. of the 20th a tornado passed through this county, to the north of this place, moving in a northeasterly direction, its path ranging in width from one hundred to two hundred yards. It is reported that while in some places everything in the path of the storm was destroyed, in others the storm apparently lifted from the ground, leaving no evidence of its existence for several miles. The storm was accompanied by rain and hail.

Calhoun, Gordon Co., Ga.: at 10.30 p. m. on the 20th a tornado occurred at this place, moving in a direction from southwest to northeast, destroying numerous buildings and causing other damage. At about 11 p. m. on the above date a violent local storm occurred in the vicinity of Austell, Cobb Co.

Mr. W. A. Simpson, postmaster at Stockton, Loudon Co., Tenn., reports the following:

The track of the destructive storm which occurred about 10 p. m. March 20th was eight or nine miles east of this place. This storm appears to have been the same one that proved so destructive at Calhoun, Ga. It is reported that an empty barrel and a piece of copper-plate were found in the path of the storm in this county, marked "Calhoun, Ga.," supposed to have been carried by the storm from the latter place, more than one hundred miles from Stockton, which appears to have been in the western edge of the storm. There was heavy rain, almost incessant lightning, and a light fall of small hail here, but the wind was only of moderate force. The course of the storm was almost parallel to the trend of our mountain boundaries and valleys. It is probable that after the storm passed Calhoun it struck the southern extremity of the Unaka Mountains, which elevated it, in passing over them, to a considerable altitude, and that it did not descend to the earth until reaching Loudon county. This storm was one of the most violent that has ever occurred in this part of Tennessee; its course was from southwest to northeast, as is usual with storms in this section.

Loudon, Loudon Co., Tenn.: a destructive local storm or tornado, path about one-fourth of a mile in width, passed in an easterly direction, about three miles south of this place, at about 10.30 p. m. (local time) on the 20th. No serious damage was done outside the path of the storm, which was accompanied by small hail.

Trim Belle, Pierce Co., Wis.: at 3 a. m. on the 21st a strong gale began to blow from the west and continued all day from the same direction, subsiding about an hour after sunset. At 10.30 a. m. the wind velocity was estimated at more than fifty miles per hour.

Mr. S. G. Lackey, voluntary observer at Mesquite, Dallas Co., Tex., reports that a severe hail storm occurred in the vicinity of Lancaster, in that county, at about 8.25 p. m. on the 25th, the path of the storm being about half a mile wide and from five to six miles in length. Hail is reported to have fallen in large quantities, killing chickens, rabbits, etc., and breaking large quantities of window glass.

Chattanooga, Tenn.: a severe thunder-storm, moving from southwest to northeast, began at 3.10 a. m. of the 26th; rain fell in torrents for fifty-six minutes, accompanied by thunder and lightning. The observer could not measure the rainfall at

the time, but thinks that not less than one inch of rain fell during the fifty-six minutes. The storm caused considerable damage in this city.

Lyons, Wayne Co., N. Y.: at about 2 o'clock a. m. on the 27th a thunder-storm, with hard dashes of rain, passed Lyons. Six miles east of this village it became more severe, and a farmer living a short distance south of Clyde was alarmed by an unusual sound. When he first went out the stars were shining, but in a few minutes a dense black cloud passed directly overhead, and from it there proceeded a loud roaring, it being apparently a tornado that did not reach the surface of the earth.

### INLAND NAVIGATION.

#### STAGE OF WATER IN RIVERS AND HARBORS.

In the following table are shown the danger-points at the various stations, the highest and lowest depths for March 1888, with the dates of occurrence and the monthly ranges:

Heights of rivers above low-water mark, March, 1888 (in feet and tenths).

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
Red River:						
Shreveport, La. ....	29.9	18	29.7	2	19.4	20.3
Arkansas River:						
Fort Smith, Ark. ....	22.0	6	10.4	24	3.5	6.9
Little Rock, Ark. ....	23.0	28	14.0	24	5.3	8.7
Missouri River:						
Omaha, Nebr. ....	18.0	24	10.0	18	6.4	3.6
Leavenworth, Kans. ....	20.0	20	13.8	3	7.8	6.0
Mississippi River:						
Saint Paul, Minn. ....	14.5					
La Crosse, Wis. ....	24.0					
Dubuque, Iowa ....	16.0					
Davenport, Iowa ....	15.0	23	7.5	19	5.6	1.9
Keokuk, Iowa ....	14.0	2, 28, 29	10.5	4	6.6	3.9
Saint Louis, Mo. ....	32.0	26	25.0	3	12.4	13.2
Cairo, Ill. ....	40.0	31	44.2	13	23.3	20.9
Memphis, Tenn. ....	34.0	31	31.0	17	18.2	12.8
Vicksburg, Miss. ....	41.0	31	30.8	1	24.4	6.4
New Orleans, La. ....	13.0	28	11.4	1	8.5	3.9
Ohio River:						
Pittsburg, Pa. ....	22.0	30	14.0	10, 11, 16	4.6	9.4
Cincinnati, Ohio ....	50.0	31	39.5	7	16.6	22.9
Louisville, Ky. ....	25.0	31	16.0	8	8.1	7.9
Cumberland River:						
Nashville, Tenn. ....	40.0	30	39.2	23, 24	7.7	31.5
Tennessee River:						
Knoxville, Tenn. ....		30	13.3	10	2.0	9.3
Chattanooga, Tenn. ....	33.0	31	27.0	20	4.8	22.2
Monongahela River:						
Pittsburg, Pa. ....	29.0	30	14.0	10, 11, 16	4.6	9.4
Savannah River:						
Augusta, Ga. ....	32.0	30	32.7	19	8.3	24.5
Sacramento River:						
Red Bluff, Cal. ....		5	5.4	1, 28-30	2.4	3.0
Sacramento, Cal. ....		1	17.5	29, 30, 31	15.4	2.1
Willamette River:						
Portland, Oregon ....		14	5.2	9, 10	2.5	2.7

\* River frozen entire month. † 13 days; river frozen from 1st to 15th, both inclusive.

The Mississippi River passed the danger line at Cairo, Ill., during the closing days of the month, and inundated the lowlands in that vicinity to a considerable extent.

The Savannah River at Augusta reached the danger line on the 30th but fell rapidly on the 31st; no serious damage resulted.

#### ICE IN RIVERS AND HARBORS.

Passamaquoddy Bay.—Eastport, Me.: floating ice in bay, 11th, 15th, 16th.

Casco Bay.—Portland, Me.: the harbor was full of drift ice on the 13th, causing suspension of navigation; there was also drift ice in harbor on the 14th and 15th; the harbor was free from ice on the 16th.

Connecticut River.—New Haven.: reports from Hartford on the 30th stated that the first boat of the season from Long Island Sound arrived on that date.

Hudson River.—Albany, N. Y.: ice began to break up on 31st.

Wynants Kill River.—Albany, N. Y.: ice broke up and moved out of river on 21st; two dams were carried away, entailing a loss of several thousand dollars.

North and East rivers.—New York City: floating ice in both rivers 5th, 6th, 14th to 18th. East River froze over on 13th.

Alleghany and Monongahela rivers.—Pittsburg, Pa.: floating ice in the Alleghany on 1st, 5th to 7th, 11th to 16th, 18th, 23d, 24th, 25th; in the Monongahela on 5th.

Sandusky Bay.—Sandusky, Ohio: the bay was clear of ice on the 20th; it froze over on the 23d, and was again clear of ice on the 27th.

Lake Erie.—Buffalo, N. Y.: the ice in the lake broke up on the 28th, and drifted down the Niagara River in large fields on the 29th and 30th.

Maumee River.—Toledo, Ohio: the river was clear of ice on the 16th. The steamer "Pathfinder" cleared for Detroit on the 20th, being the first departure of the season.

Grand River.—Lansing, Mich.: ice moved out of river on 19th; river froze again on 22d, and was clear of ice on 26th.

Grand Haven, Mich.: heavy drift ice in river, 16th, 27th. The river opened on the 10th and was entirely free of ice on 31st.

Saint Clair River.—Port Huron Mich.: steamer "Mary" arrived from Algonac, Mich., on the 10th, when navigation between that place and Port Huron was considered open for the season. There was floating ice on the 1st, 4th, 11th, 12th, 29th.

Black River.—Port Huron, Mich.: the ice in the river disappeared on the 29th.

Lake Michigan.—Milwaukee, Wis.: two propellers were fast in the ice near the harbor entrance from early a. m. on the 24th until 6 p. m. on the 26th. The mild weather of the last week of the month, together with the high winds, cleared the lake of ice to a very great extent, so that no ice was in sight at this station on the 31st.

Mississippi River.—Dubuque, Iowa: ice began to move on the afternoon of 31st.

Davenport, Iowa: ice began to move on the 18th and by morning of the 19th the river was free of ice; floating ice was observed on the afternoon of the latter date, and from the 20th to 24th.

Muscataine Co., Iowa: ice moved out of river during the 15th and 16th.

Keokuk, Iowa: the ice dam in the river broke during a. m. of the 2d. The packet "Patience" began making regular trips between Keokuk and Warsaw, Ill., on the 7th. Steamers "Sidney" and "War Eagle" arrived on the 15th from Saint Louis, being the first arrivals from that place this season. Floating ice in river, 9th and 22d.

Little Sioux River.—Smithland, Woodbury Co., Iowa: the ice moved out of the river on the 19th.

Maquoketa River.—Monticello, Jones Co., Iowa: the ice moved out of the river on the 16th.

Cedar River.—Vinton, Benton Co., Iowa: the ice moved out of river on the 18th.

Missouri River.—Fort Sully, Dak.: ice began to disappear rapidly on 14th; river free of ice on the 30th.

Yankton, Dak.: the ice in river began to break up and move out at 9 a. m. on 19th.

Omaha, Nebr.: ice broke during the night and moved down the stream on the 16th.